

The Urinary System

Anatomy & Physiology Block

Spring semester

Academic Year 2013 - 2014

Basic Sciences Department

College of Sciences and Health professions



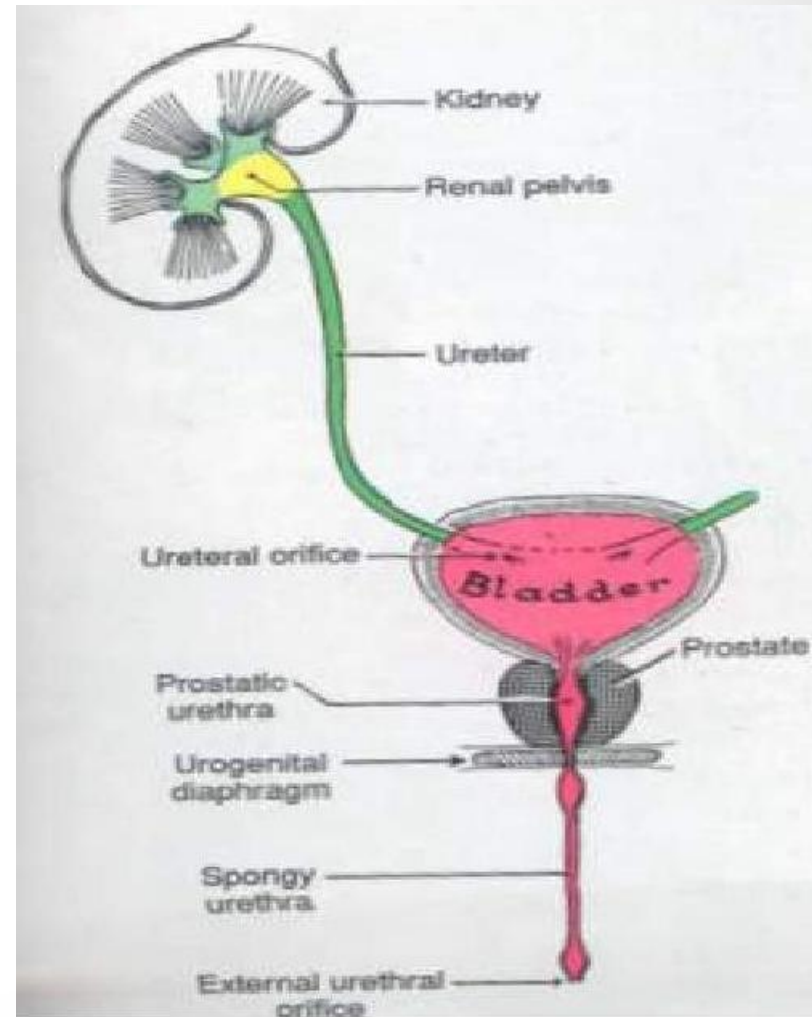
Block Objectives

- List the components of the urinary system
- Describe the anatomy; shape, relations, hilum and blood supply of the kidney
- Describe the anatomy; extension, relations, constrictions and blood supply of the ureters
- Describe the anatomy; shape, relations, and blood supply of the urinary bladder
- Describe the anatomy of the male and female urethra

Components of the urinary system

The urinary system comprises of:

- Kidneys
- Ureters
- Urinary bladder
- Urethra



Functions of the urinary organs

Kidneys

- Filtration: to remove toxins, metabolic waste
- Excretion of nitrogenous waste: urea, uric acid, creatinine
- Regulation of blood volume
- Regulation pH of extra cellular fluid
- RBC synthesis
- Vit. D synthesis

Ureters

- Act as conduit for the passage of urine from kidneys to urinary bladder

Urinary bladder

- Storage of urine temporarily before it is expelled

Urethra

- Transports urine out from the urinary bladder

KIDNEY, External features

SIZE: 12x6x3 cm; **WAIGHT:** about 130 gm

SHAPE: bean shaped

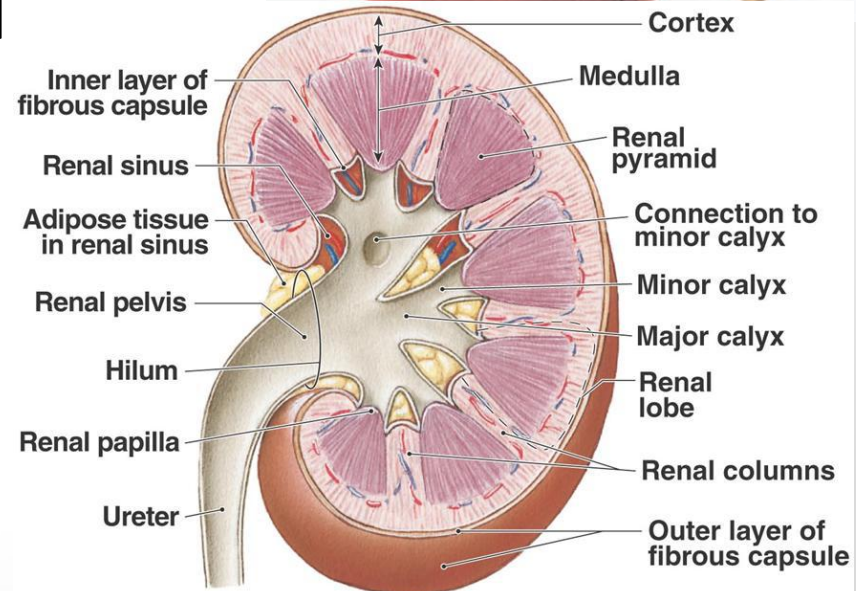
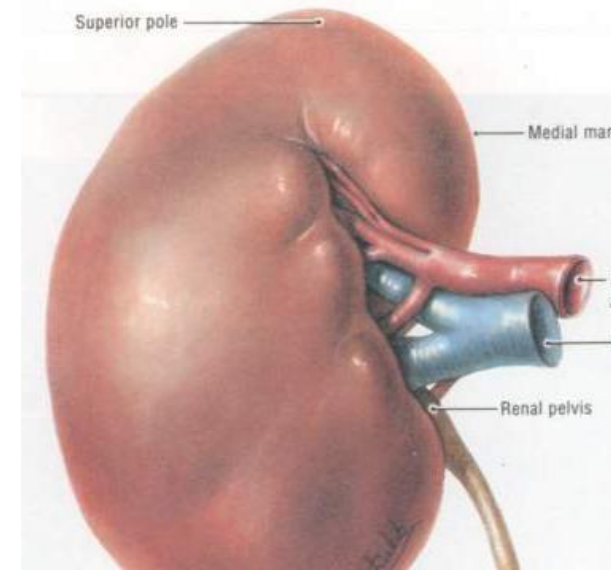
SURFACES: Anterior & Posterior

POLES: Superior & Inferior

BORDERS: Lateral & Medial

Hilum of kidney: It is area on the medial border where structures (artery, vein, ureter) enter and leave kidney

Renal Sinus: Renal sinus is space which contains the upper expanded end of the ureter the **renal pelvis**



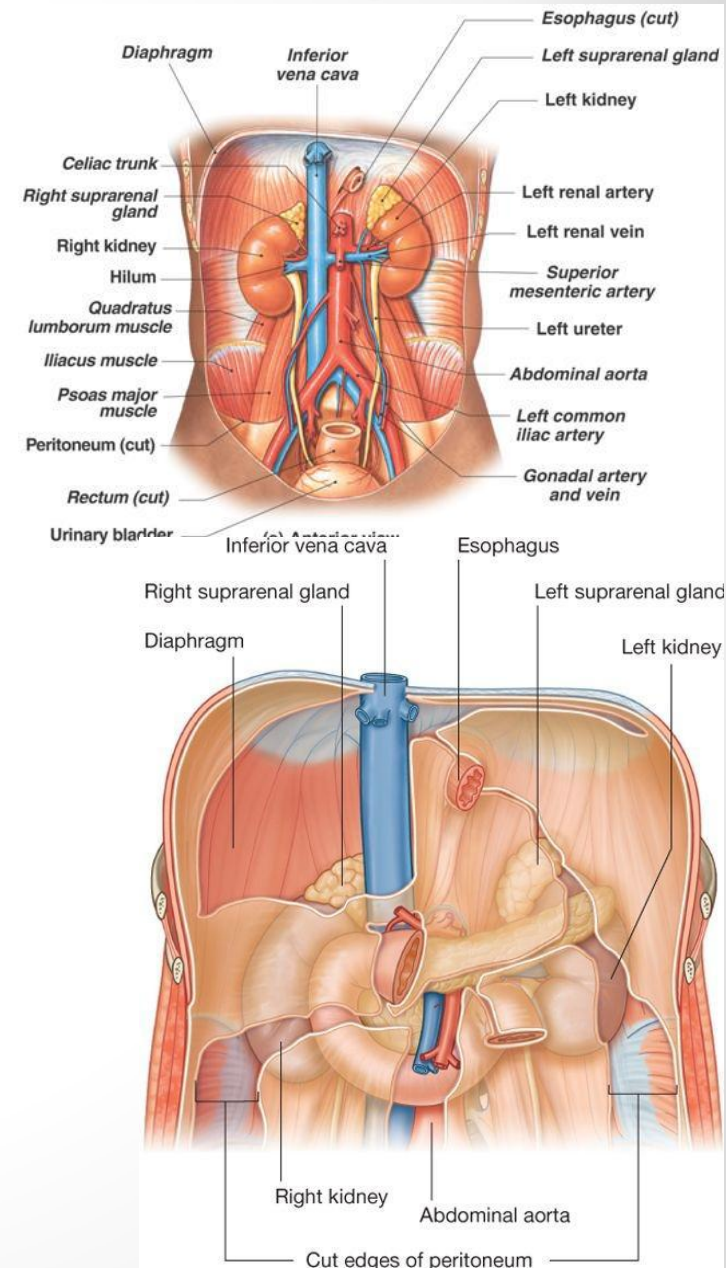
(a) Frontal section of left kidney, anterior view

Position & relations of Kidneys

- Kidneys are **retroperitoneal organs** which lie obliquely in the superior lumbar region on **posterior abdominal wall**
- Right kidney** lies slightly lower than the **left**. **Right kidney** may be palpated in thin individuals at the end of deep inspiration
- The levels of the kidneys alter with respiration and posture

Anterior relations

- Right Kidney:** Rt. suprarenal gland, Liver, 2nd part of the duodenum, Rt. colic flexure
- Left Kidney:** Lt. Suprarenal gland, Spleen, Stomach, Pancreas, Lt. colic flexure, Coils of jejunum



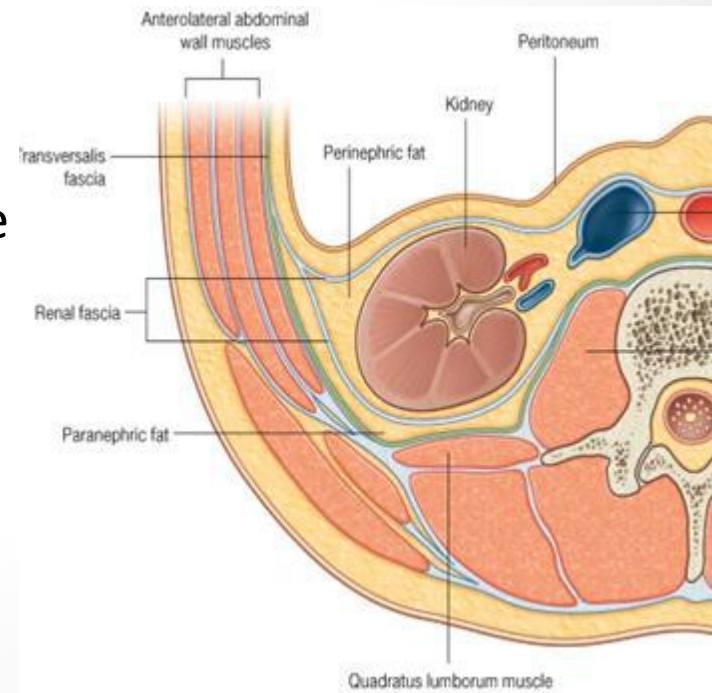
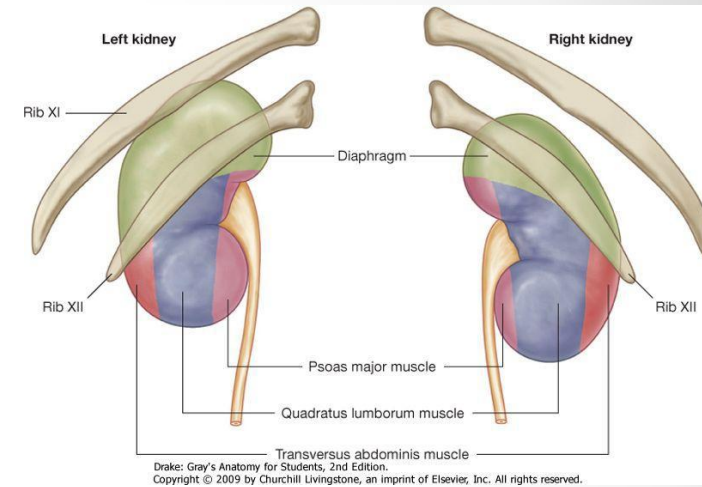
Relations & coverings of Kidneys

Posterior relations

- Diaphragm, costodiaphragmatic recess of the pleura, muscles (psoas, quadratus lumborum, and transversus abdominis), 3 nerves (subcostal, iliohypogastric, ilioinguinal) running downward and laterally
- 12th rib (Rt. kidney), 11&12th ribs (Lt. kidney)

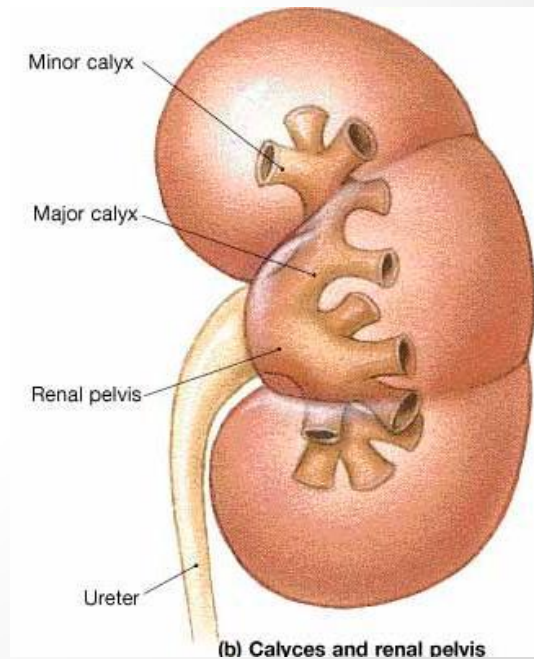
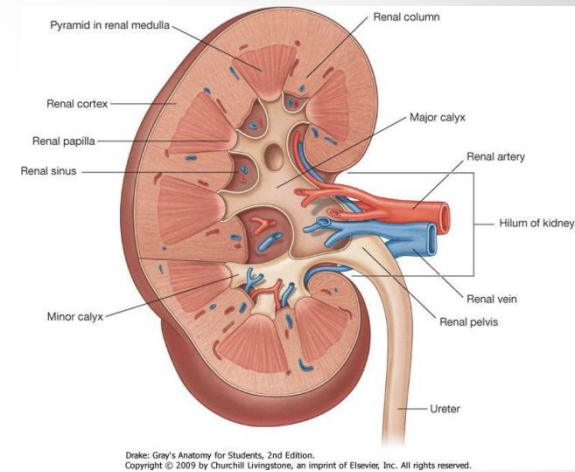
Coverings

- **Fibrous capsule:** closely applied to the kidney
- **Peri-renal (peri-nephric) fat:** surrounds the capsule and acts as a shock absorber, holds the kidney in place
- **Renal fascia:** Anchors the kidney to the abdominal wall
- **Pararenal fat:** external to the renal fascia, hold the kidneys in position on the posterior abdominal wall



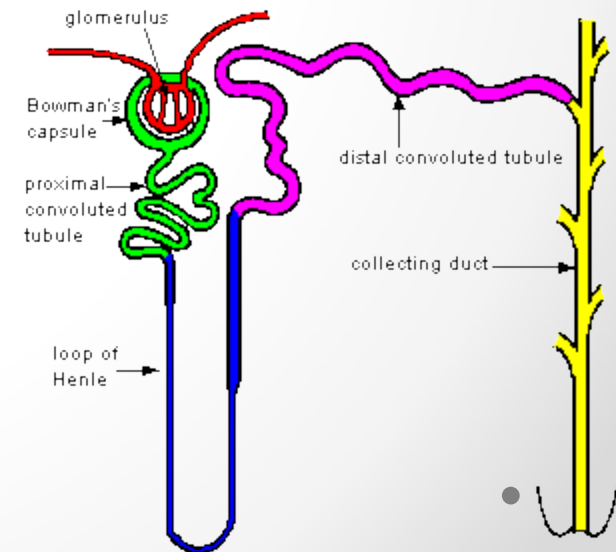
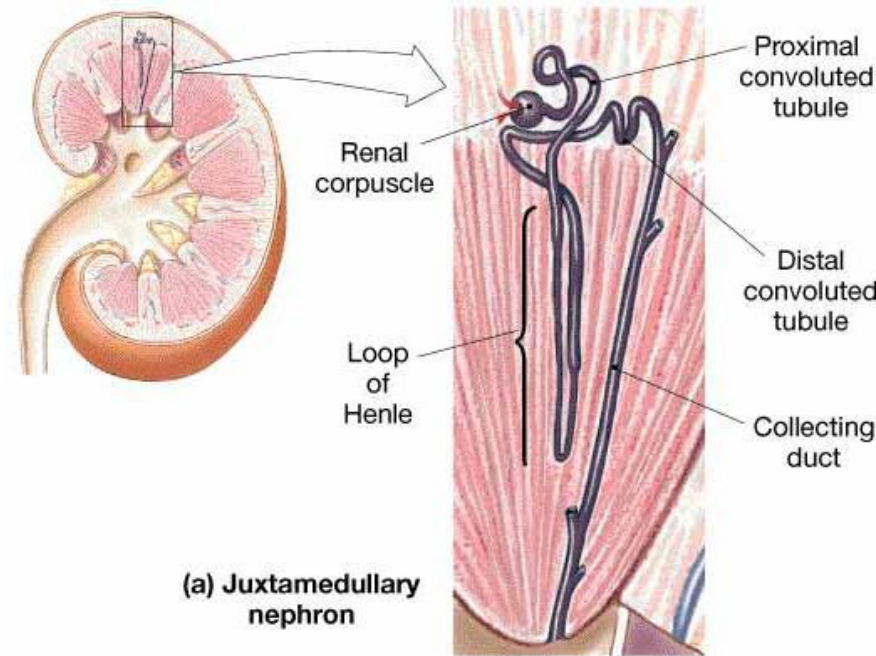
STRUCTURES OF KIDNEY

- **CORTEX:** is an outer peripheral zone that extends into the medulla between adjacent pyramids as the renal columns
- Extending from the bases of the pyramids into the cortex are striations called **medullary rays**
- **MEDULLA:** is inner to cortex, composed of **renal pyramids**, the bases of which are towards the cortex, and the apices (renal papilla) medially
- **Renal pelvis:** It is an expanded, funnel shaped, superior part of ureter present in the in the renal sinus. It divides into 2-3 short tubes, **the major calices**
- Each **major calyx** divides again into 7-14 **minor calices**
- Each **minor calyx** receives the openings of **collecting tubules** on the papilla of the pyramid that projects into the minor calices



Functional and structural unit of kidney

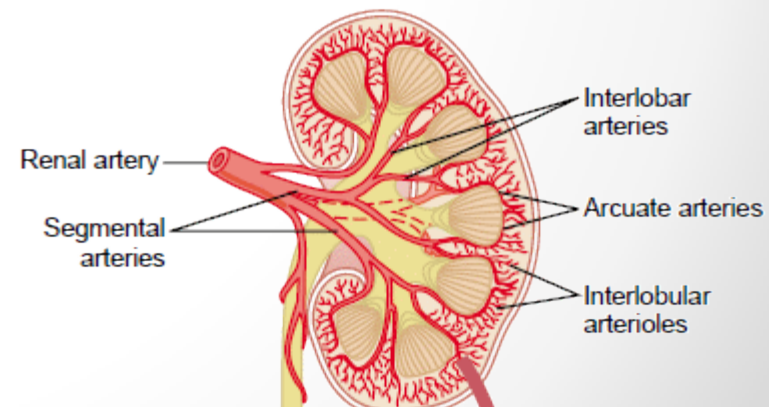
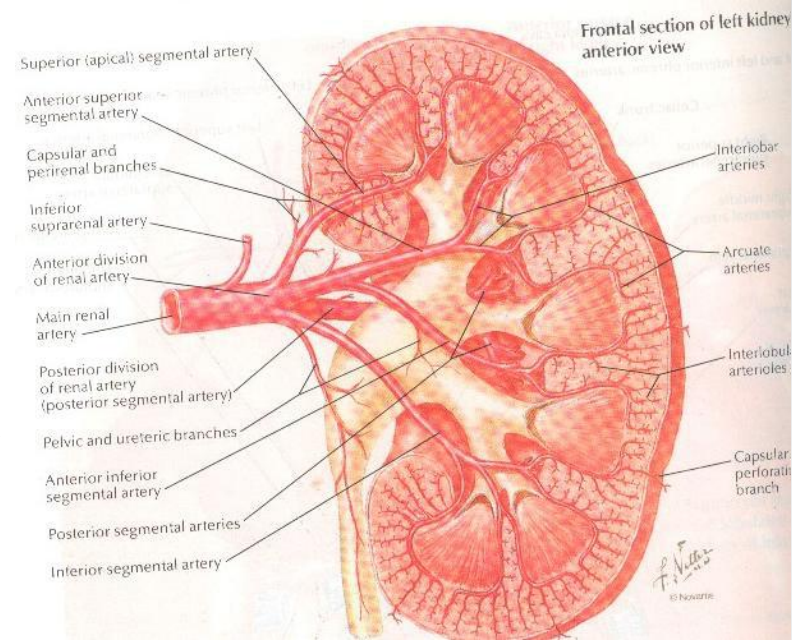
- **A nephron** is an structural and functional unit of the kidney. Each kidney has about 1 million nephrons. Each nephron consists of following parts:
- **Renal corpuscle** which consists of a **glomerulus**: A tuft of capillaries in the **bowman's capsule**
- **Bowman's capsule**: Proximal cup shaped part of the renal tubule
- **Uriniferous tubules** which consist of: **Proximal tubule**, **Intermediate tubule**, **Distal tubule**, and **Collecting duct**



BLOOD SUPPLY OF KIDNEYS

About 20 to 25% of cardiac output goes to kidneys

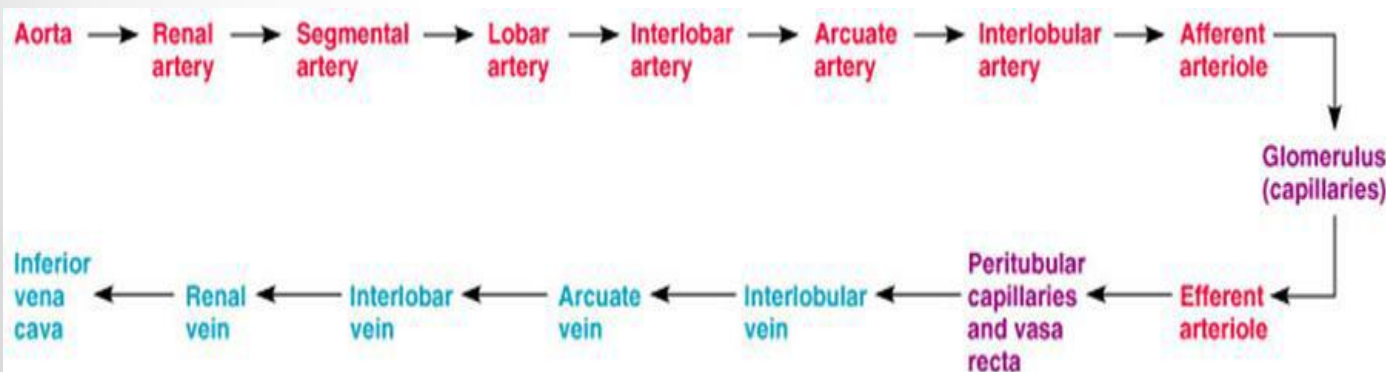
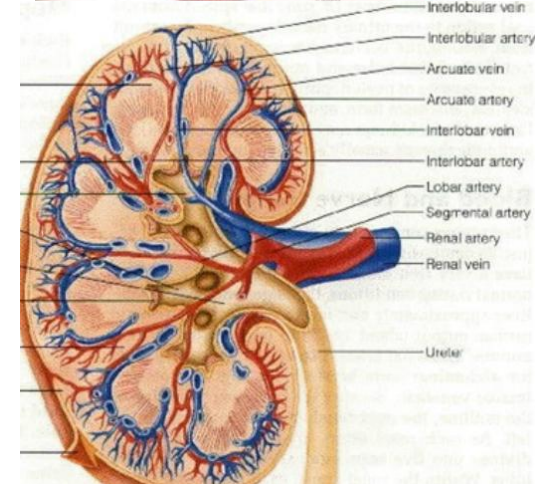
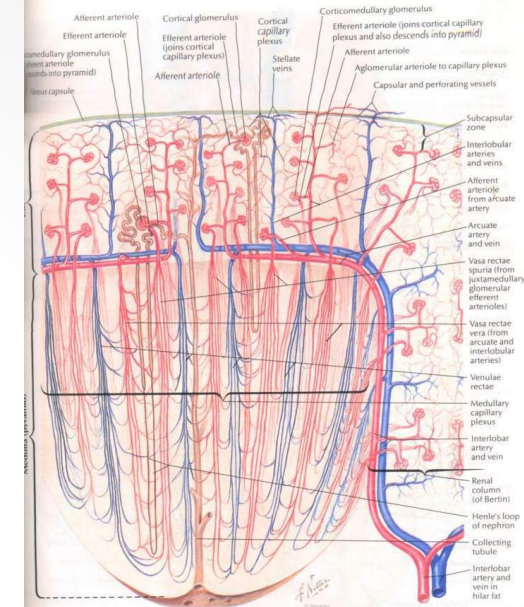
- **Renal Arteries:** Rt. and Lt. renal arteries arise from aorta at the level of L2
- Each renal artery divide into 5-6 **segmental arteries**, as it enters the hilum of the kidney
- **Segmental arteries** branch into **interlobar arteries** which run between the lobes / pyramids
- **Interlobar arteries** form **arcuate arteries** at the base of pyramids
- **Arcuate arteries** send **interlobular arteries** into cortex
- **Interlobular arteries** give rise to **afferent glomerular arterioles**



Venous drainage

Interlobular veins to arcuate veins to interlobar veins to lobar vein to the renal vein which drains into IVC

- The renal vein emerges from the hilum in front of the renal arteries and drains into IVC
- **Lymph Drainage:** Lymph drains to lateral aortic lymph nodes around renal artery origin
- Because 25% of the cardiac outflow passes through the kidneys, renal injury can result in rapid blood loss



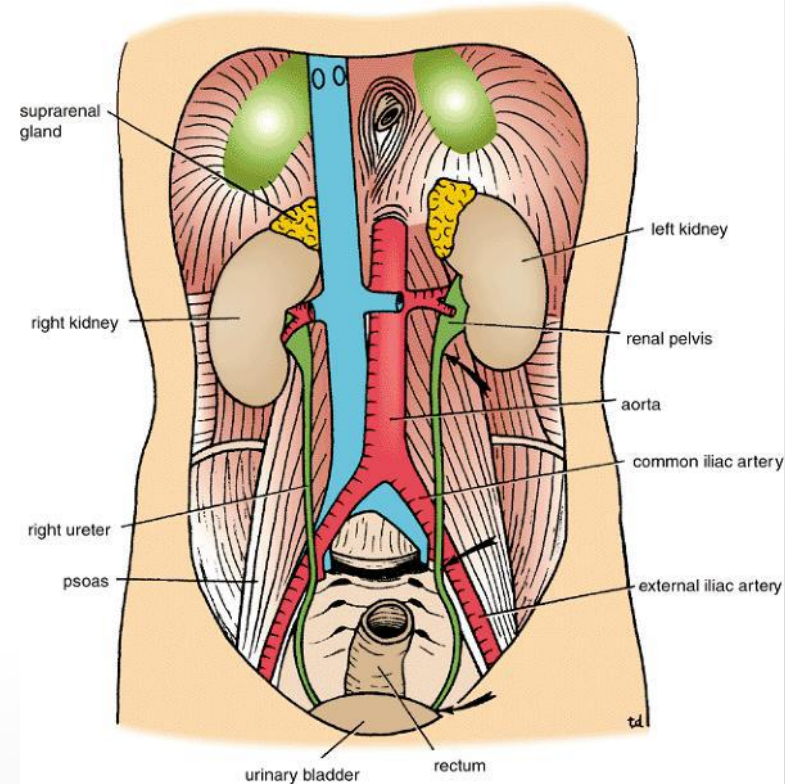
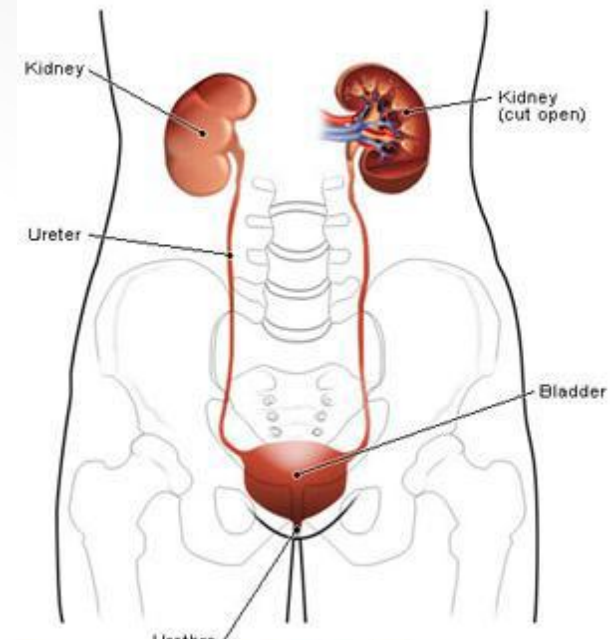
The Ureters

The ureters are about 25 cm long tubes leaving each renal pelvis, carrying urine to the bladder

- Descend behind the peritoneum and **cross pelvic brim**
- Enter obliquely on the **posterolateral corners of bladder**
- This oblique entry acts as a valve and **helps prevent backflow of urine**

There are 3 constrictions of the ureter along its course where kidney stones may be arrested:

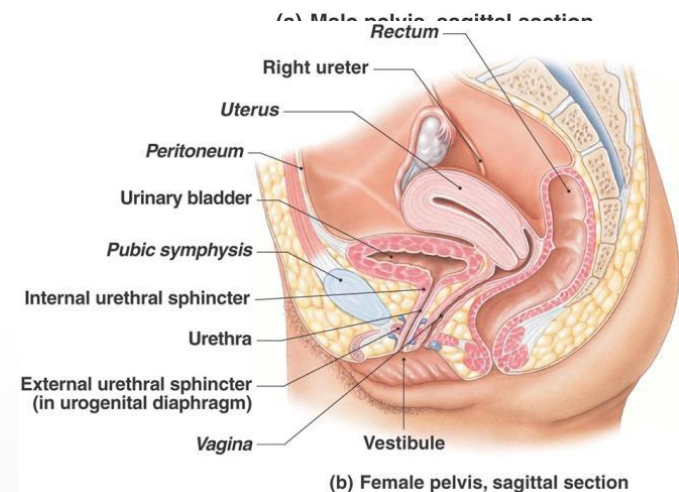
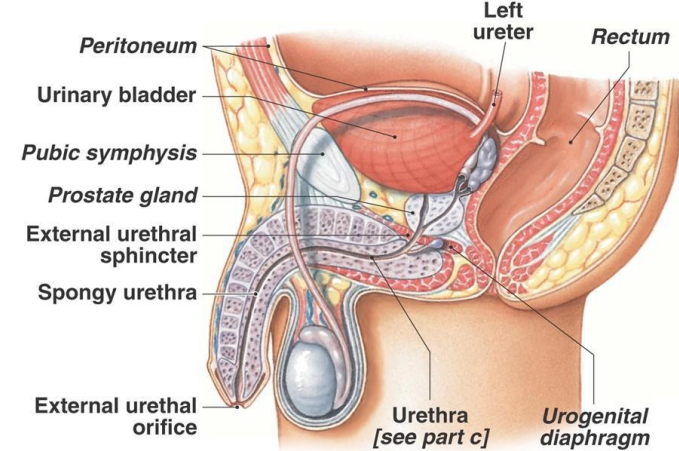
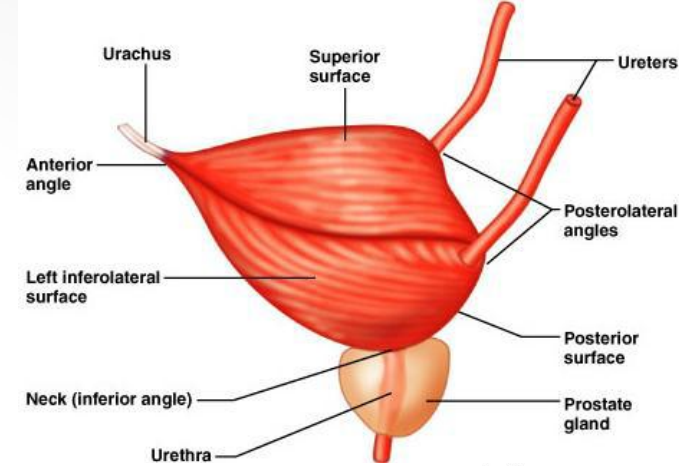
- **Pelviureteral junction**: Where the renal pelvis joins the ureter
- **Pelvic brim**: Where it is kinked as it crosses the pelvic brim
- **Bladder**: Where it pierces the bladder wall



Urinary Bladder

It is distensible muscular sac that stores and expels urine

- Lies on pelvic floor posterior to pubic symphysis; **in males** anterior to rectum and **in females** anterior to the vagina and uterus
- It has **an apex**, a **base**, a **superior surface**, and **two inferolateral surfaces**
- **The apex** is directed toward the top of the pubic symphysis
- **The base** is shaped like an inverted triangle and faces posteroinferiorly
- **The two ureters** enter the bladder at each of the upper corners of the **base**, and the **urethra** drains from the lower corner of the base



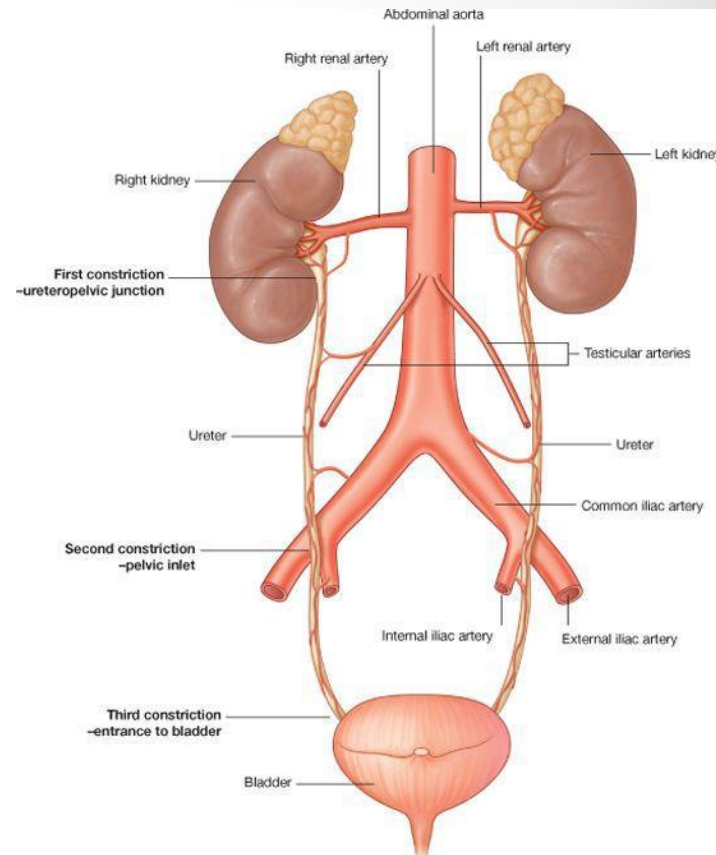
Blood and Nerve supply

Ureters

- **Arteries:** upper end by the **renal A.**; middle portion by the **testicular or ovarian A.**; the pelvic portion by the **superior vesical A.**
- **Veins:** veins that correspond to the arteries
- **Lymph Drainage:** aortic and the iliac nodes
- **Nerve Supply:** the renal, testicular (or ovarian), and hypogastric plexuses

Urinary Bladder

- **Arteries:** **Sup. & Inf. Vesical A.** from the internal iliac A.
- **Veins:** **Vesical venous plexus**, communicates with the prostatic plexus, drain into the internal iliac vein
- **Lymph drainage:** internal & external iliac nodes

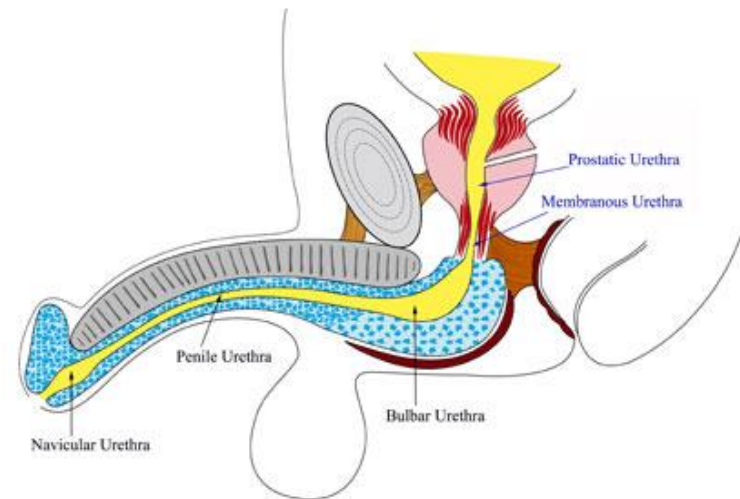
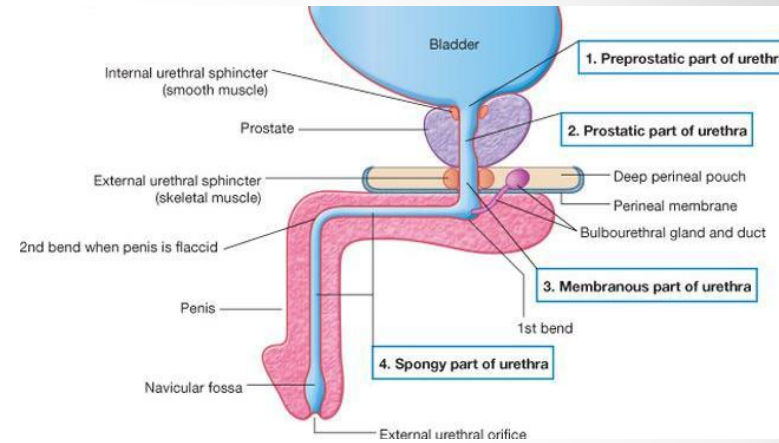


Nerve supply of Urinary bladder

- Sympathetic and parasympathetic nerves through the inferior hypogastric plexuses
- Most afferent sensory fibers arising in the bladder reach the central nervous system via the pelvic splanchnic nerves
- The sympathetic nerves inhibit contraction of the detrusor muscle of the bladder wall and stimulate closure of the sphincter vesicae
- The parasympathetic nerves stimulate contraction of the detrusor muscle of the bladder wall and inhibit the action of the sphincter vesicae

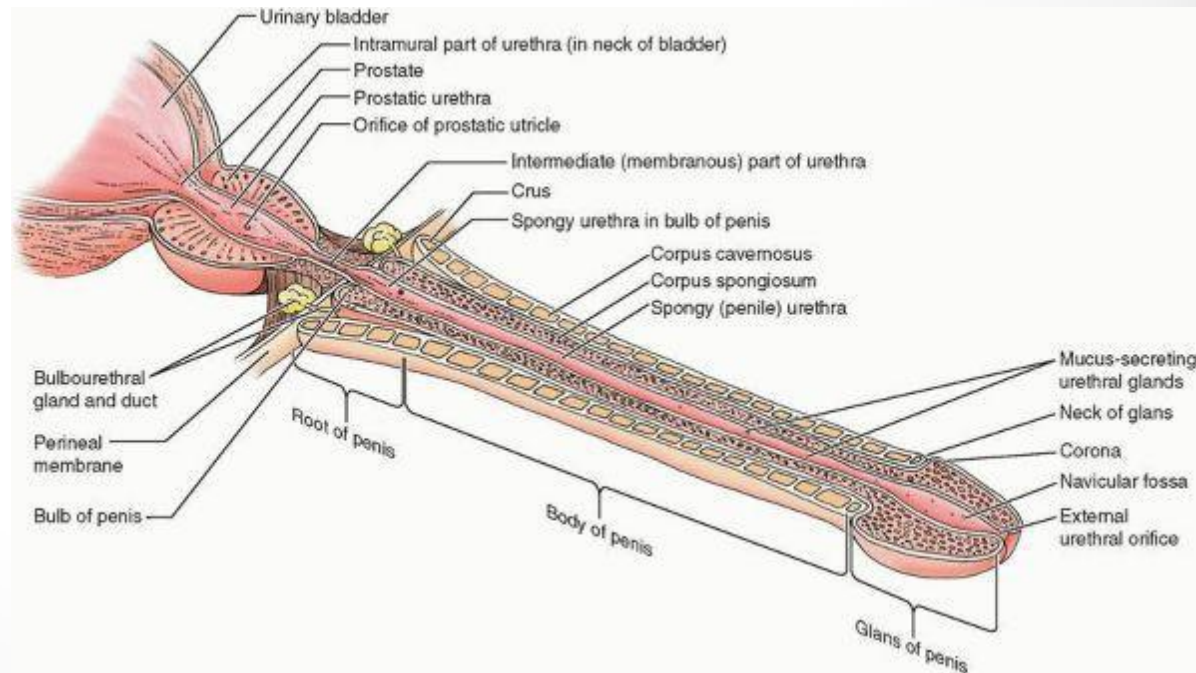
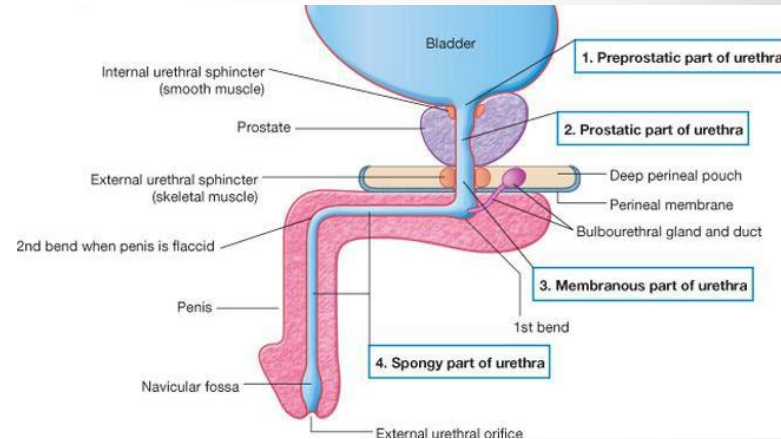
Male Urethra

- The male urethra is about 20 cm long and extends from the neck of the bladder to the external meatus
- It is divided into three parts: **prostatic**, **membranous**, and **penile**
- **The prostatic urethra** is about 3 cm long and passes through the prostate
- It is the widest and most dilatable portion of the urethra
- **The membranous urethra** is about 1.25 cm long and lies within the urogenital diaphragm. It is the least dilatable portion
- **The penile urethra** is about 15.75 cm long traversing through the bulb and the corpus spongiosum of the penis



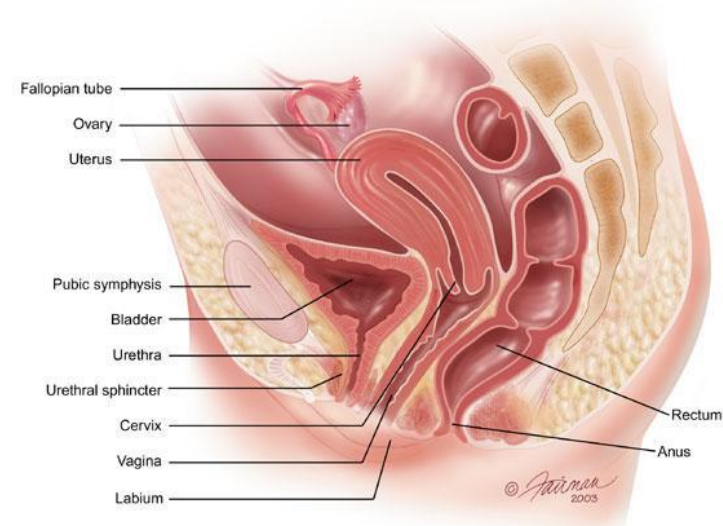
Male Urethra

- The **bulbourethral glands** open into the **penile urethra** below the urogenital diaphragm
- The **external urethral meatus** is the narrowest part of the entire urethra
- The **navicular fossa** is a the part of the urethra that lies within the glans penis



Female Urethra

- It is about 3.8 cm long tube which extends from the **neck of the urinary bladder** to the external meatus where it opens into the **vestibule of the vagina, below the clitoris**
- It traverses the external urethral sphincter in front of the vagina
- At the sides of the external urethral meatus are the small openings of the ducts of the **paraurethral glands**



Urinary Bladder and Urethra – Female

